Portable electricity, life-like prosthetics on the way

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The technology that makes a cell phone vibrate is the same technology that provides more natural movements to prosthetic limbs. A University of Houston research team is working on recreating and enhancing this technological effect, which, if successful, could result in better prosthetic movements and also provide instant electrical power for soldiers and others through the simple act of walking.

Pradeep Sharma, a UH mechanical engineering professor, is leading the team to create a “piezoelectric on steroids.” Piezoelectricity is the ability of some materials to generate an electric charge when placed under stress. This pioneering technology already is more useful than many people realize. Piezoelectrics are involved in everything from making an airbag deploy to how a lighter produces a flame.

Although piezoelectrics are naturally occurring, they have their limits. If an application requires a level of energy conversion not found in a naturally occurring piezoelectric, a composite consisting of piezoelectrics and non-piezoelectrics must be made. Sharma and his team are creating piezoelectrics from man-made materials that have no piezoelectric property.

“If you press on a piezoelectric, or apply mechanical force, it will produce a voltage,” Sharma said. “Or, if you apply a voltage or electrical force to it, the object will bend or change its shape.”

An engineered piezoelectric strip placed in the boot of a soldier would

generate electricity and power the increasing number of devices that soldiers carry. The walking motion produces force or deformation of the strip, which generates electricity with every step. The highly customizable piezoelectrics also could enable the creation of prosthetics that come closer to offering both the flexibility and the strength of real limbs. Current prosthetic limbs face challenges in range and movement by the two types of naturally occurring piezoelectrics, ceramic and polymer.

“Ceramic piezoelectrics are very hard and brittle, and don’t allow for a lot of movement,” Sharma said. “They take a lot of electrical energy for a lot of motion. Polymers are better for large forces of motion, but don’t have a lot of strength. So, you can stretch adequately, but may not even be able to pick up an egg. Nature has given us some elements, and now we’re going beyond and designing materials from the ground up. We wanted to combine the best qualities of the two types of piezoelectrics, among other things.”

Sharma has been working to refine his theoretical ideas for two years. His research team includes Ramanan Krishnamoorti of the UH Cullen College of Engineering, Boris Yakobson of Rice University and Zoubeida Ounaies of Texas A&M University. Krishanmoorit and Ounaies will begin putting the research to the test with the help of a $1.22 million grant from the National Science Foundation.

“The real applications of this technology are going to come from the fact that you don’t have to depend on existing piezoelectrics,” Sharma said. “You can create materials, using certain nanoscale effects, that give higher energy conversion. These are basically piezoelectrics on steroids.”

Source: University of Houston